REMARKS

Reconsideration and further examination of this application is hereby requested. Claims 1-13 are currently pending in the application.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached pages are captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE".

A. Objections to the Specification

The Examiner has objected to various informalities of language in the specification. Applicant thanks the Examiner for the careful critique of the spelling and grammar of the specification. Clarifying amendments have been made to the specification to rectify most of the informalities of language noted by the Examiner. Applicant has chosen not to amend the language noted on page 36.

As to the differences in language between the specification and dependent claims 9 and 10 that the Examiner noted, these differences have been rectified by amending claims 9 and 10 to recite verbatim the "fixed" language used in the specification. These amendments to claims 9 and 10 have not been made for the purpose of avoiding any prior art.

Accordingly, Applicant respectfully submits that these

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objections have been overcome by amendment.

B. Objection to Claim 1

The Examiner objects to claim one as misspelling the word "angle" and for containing the grammatically inappropriate phrase "so as to." Applicant thanks the Examiner for the careful critique of the spelling and grammar of claim 1 and has amended to claim 1 to rectify these minor informalities of language. These amendments to claim 1 have not been made for the purpose of avoiding any prior art.

Accordingly, Applicant respectfully submits that these objections have been overcome by amendment.

C. The Interview

Applicant thanks Examiner Glass and SPE Ham for the courtesy extended in the interview of April 2, 2002. A brief summary of the discussion during the interview follows.

Concerning claim 1, it was agreed that this claim defines over the Messina reference since the limitation of "progressing to a subsequent scan position by rotating the gimbal about the outer axis" is not evidenced by Messina. This is discussed in more detail below, in the analysis of the anticipation rejection.

Concerning claim 2, no agreement was reached. The possibility of amending claim 2 to recite a limitation including the words "conical arc path" or similar language was discussed.

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However, no agreement was reached on this point, and in any case, such an amendment has not been made.

Concerning claim 13, the "scanned across the field of regard in a conical arc" limitation was discussed. The undersigned explained how this was different from the scanning disclosed by Messina. The Examiner and SPE indicated that they would take this argument under advisement when a reply to the Office Action is submitted. A detailed argument making this point is set forth below, in the analysis of the anticipation rejection.

D. The Anticipation Rejection

Claim 1-13 have been rejected under 35 U.S.C. § 102(b) as being anticipated by Messina (U.S.P. 5,672,866). This rejection is respectfully traversed based on the following arguments.

In order for a patent claim to be anticipated by the prior art, each and every limitation of that claim must be disclosed (explicitly or inherently) within a single prior art reference. That is the law of anticipation. The Messina reference fails to meet this criterion concerning claims 1-13.

D.1. Patentability of Claim 1

Independent claim 1 recites the limitation of "progressing to a subsequent scan position by rotating the gimbal about the outer axis." This is not how the imaging system of Messina works. In Messina, progressing to a subsequent scan position is

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done by turning around the aircraft the imaging system is mounted in so that the imaging system can be then be flown along a parallel scan path. Rather than being used for progressing to a subsequent scan position, the outer axis in Messina is simply used for the main scanning function as the aircraft advances along a scan path.

Simply put, Messina does not disclose this limitation. Accordingly, the Messina reference does not anticipate claim 1.

D.2. Patentability of Claims 2-5 and 12

Independent claim 2 (as amended) recites the limitation that "the flat mirror sweeps the field of view continuously across the field of regard." In contrast, the scanning apparatus taught by Messina steps its way across the field of regard in a so-called stop-and-stare format that points the field of view at discrete blocks of the field of regard one at a time. This is hardly a continuous sweep of the field of view across the field of regard.

Since the apparatus of Messina does not sweep the field of view continuously across the field of regard, it does not anticipate claim claims 2-5 and 12.

D.3. Patentability of Claims 6-11 and 13

Claim 6 has been amended to be in independent form. Claim 6 recites the limitation that "the field of view covers the two dimensional field of regard via a series of conical arcs."

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Independent claim 13 recites a similar limitation. The system of Messina does not do this. Rather, the imaging system of Messina scans by pointing its field of view at discrete portions of the field of regard, selecting the position of each subsequent stop-and-stare position according to where the pilot of the aircraft carrying the system selects to steer the aircraft. Such a system would not cover the field of regard according to a series of conical arcs.

Accordingly, Messina does not anticipate claims 6-11 and 13.

E. Closing

In view of the above, Applicant respectfully submits that independent claims 1, 2, 6, and 13 are patentable over the prior art of record. Applicant further submits that dependent claims 3-5, and 7-12 are patentable, at least as being dependent from patentable independent claims, and are further patentable due to the additional limitations recited therein.

For the above reasons, Applicant respectfully submits that the application is in condition for allowance with claims 1-13. If there remain any issues that may be disposed of via a telephonic interview, the Examiner is kindly invited to contact the undersigned at the local exchange given below.

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The Commissioner is authorized to charge any necessary fees, and conversely, deposit any credit balance, to Deposit Account No. 18-1579.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

Amend the paragraph at lines 11-20 of page 7 as follows:

To achieve the desired match between opto-mechanical and electronic scans, two conditions need to be satisfied for all scan angles within the FOR. Ideally, the projection of the TDI axis of each FPA onto the Earth's surface must always lie along the direction of the opto-mechanical scan. [If not] Without this provision, the pixels in the image will be blurred in the cross-scan direction. Also according to the ideal case, the angular scan speeds of the LOS due to the electronic scan and the optical rate and the scan rates must be also equal. [If not] Without this provision, the pixels will be blurred in the along-scan direction. If both of these conditions are satisfied, then the outputs from the array will have the angular resolution as a single detector element [,] but an effective dwell time per pixel equal to N times the integration period of a single cycle, where N is the number of columns summed in the TDI (N=4 in the illustrated example).

Amend the paragraph at lines 12-20 of page 11 as follows:

Between these arcs, the orientation of this inner axis is offset by rotation about the outer gimbal axis. The outer gimbal needs only to be capable of holding a small number of fixed positions, with the mechanical angle between positions no greater than one-half of the optical width (cross-scan) of the scanned arcs. These factors tend to simplify the apparatus required to measure and control the rotational angle of the outer axis. The position of the outer gimbal must be known to the same level of accuracy as that of the inner gimbal, however. The angular velocity of the mechanical scan is held constant during any given arc. However [is preferred] it is preferable to change the angular velocity from arc-to-arc, in order to maintain the same optical scan rate for each arc.

Amend the paragraph at line 18 of page 12 through line 6 of page 13 as follows:

Some of the above objects are achieved by a method of scanning a field of view of an imager across a field of regard using a scan mirror mounted on a gimbal having an inner axis and an outer axis. The method includes sweeping the field of view across the field of regard in a selected direction by rotating the gimbal about the inner axis while maintaining the gimbal at a fixed [angel] angle with respect to the outer axis [so as to].

The method further includes progressing to a subsequent scan position by rotating the gimbal about the outer axis by a predetermined increment angle while maintaining the gimbal at a fixed angle with respect the inner axis. Additionally, the method includes repeating the act of sweeping such that the selected direction is chosen alternately from a first direction and a second direction that is opposed to the first direction. The method further includes repeating the act of progressing prior to each repeated act of sweeping, wherein there is substantially no rotation, with respect to the instantaneous direction of scan, of an image formed on the imager.

Amend the paragraph at line 21 of page 17 through line 5 of page 18 as follows:

Reference measurements are made at the beginning and the end of each arc, while the LOS is pointing to space. The reflection angle from the scan mirror reaches a minimum at the center of each arc in the FOR. It exhibits only a slow, quadratic increase towards each end of the arc (the eastern and western sides of the Earth's disk) as [a] the scan mirror is rotated about the inner gimbal's axis. The large variations in scan angle occur between arcs rather than within an arc. In this geosynchronous imager embodiment, measurements of dark space are used as references to

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subtract the instrument's background from the raw signals. The time interval between reference and scene measurements is short, minimizing degradations caused by thermal drifts and 1/f noise.

Amend the paragraph at line 10 of page 26 through line 2 of page 27 as follows:

In the thermal IR channels, each mirror in the optical train emits background radiation that contributes to all signals measured by the detectors. This background from each optical element is proportional to its emissivity and increases with temperature according to Planck's law. Space looks, taken at the ends of each scan line when looking past the Earth into space, are used to measure the dark current due to instrumental background. This background is then subtracted from the raw scene data to determine the net radiance from the Earth. All components of the background due to thermal radiation from within the instrument are properly subtracted from the signal whenever they remain constant during a single scan line. All optical elements have temperatures that remain virtually constant during a single scan line, and all except the scan mirror **818** reflect the radiation from the scene in a fixed orientation, so their emissivities also remain constant. The scan mirror **818**, however, reflects radiation at a variable angle over the course of a scan

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line. When the scan mirror's emissivity varies as a function of the reflection angle, it creates a bias in this background subtraction process that is proportional to the difference in emissivity between the reflection angle of the scene measurement and that of the background measurement. Therefore, variation in the reflection angle within a scan line is more troublesome that variation in the reflection angle from line to line.

Amend the paragraph at lines 12-16 of page 34 as follows:

Referring to Fig. 12, a bi-directional scan pattern **1210** for mapping the full Earth disk that is generated by the system of Fig. 11 is illustrated. Comparing the scan pattern of Fig. 12, with that of Fig. 7, the arcs in Fig. 12 are more nearly straight lines. This <u>is</u> yet another way of characterizing that image rotation is reduced according to this preferred embodiment.

<u>IN THE CLAIMS</u>:

Amend claims 1, 2, 6, 9, and 10 as follows:

1. *(Once Amended)* A method of scanning a field of view of an imager across a field of regard using a scan mirror mounted on a gimbal having an inner axis and an outer axis, the method comprising:

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sweeping the field of view across the field of regard in a selected direction by rotating the gimbal about the inner axis while maintaining the gimbal at a fixed [angel] angle with respect to the outer axis; [so as to;]

progressing to a subsequent scan position by rotating the gimbal about the outer axis by a predetermined increment angle while maintaining the gimbal at a fixed angle with respect the inner axis;

repeating the act of sweeping such that the selected direction is chosen alternately from a first direction and a second direction that is opposed to the first direction; and

repeating the act of progressing prior to each repeated act of sweeping;

wherein there is substantially no rotation, with respect to the instantaneous direction of scan, of an image formed on the imager.

2. *(Once Amended)* An apparatus for scanning a two dimensional field of regard, the apparatus comprising:

a telescope having a focal plane and a field of view;

one or more image sensors disposed at the focal plane;

a single optically flat mirror disposed in the object space of the telescope;

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wherein the flat mirror [scans] sweeps the field of view continuously across the field of regard while maintaining a fixed relationship between the rotational direction of scan and the projection of the telescope's focal plane.

6. *(Once Amended)* [The] An apparatus [of claim 2, further] for scanning a two dimensional field of regard, the apparatus comprising:

a telescope having a focal plane and a field of view;

one or more image sensors disposed at the focal plane;

a single optically flat mirror disposed in the object space of the telescope; and

a gimbal having an inner axis and an outer axis, the flat mirror being mounted on the gimbal;

wherein the flat mirror scans the field of view across the field of regard while maintaining a fixed relationship between the rotational direction of scan and the projection of the telescope's focal plane; and

wherein the field of view covers the two dimensional field of regard via a series of conical arcs, each arc being scanned by rotation about the inner axis of the gimbal.

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9. *(Once Amended)* The apparatus of claim 7, wherein rotation about the outer axis of the gimbal is [constant] <u>fixed</u> during the active scanning portion.

10. *(Once Amended)* The apparatus of claim 7, wherein rotation about the inner axis of the gimbal remains substantially [constant] <u>fixed</u> during the vertical deflection interval.

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